EFFECTS OF SHOCK PRESTRAIN ON THE MICROSTRUCTURE AND MECHANICAL BEHAVIOR OF TANTALUM AND TANTALUM-TUNGSTEN ALLOYS

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The purpose of this study was to examine the effects shock prestrain on the microstructure and reload behavior of unalloyed Ta, and Ta-2.5%W and Ta-10%W alloys. The test materials were shocked to 45 GPa for 1.8 μs and soft-recovered such that deformation that occurred during this procedure was predominantly due to the shock loading. To assess the mechanical response of shock-prestrained tantalum we have tested the annealed and shock-recovered tantalum over a wide range of strain rates (10^{-4} to 4500 s^{-1}) in compression. Optical light microscopy was performed to assess the effects of shock loading on the microstructures.

Shock prestraining caused an increase in the yield and flow stress in all of the test materials (the behavior of unalloyed Ta is shown in Figure 1.) The test results suggest that the athermal component of the flow stress is altered and to some extent work hardening is exhausted. The effects of shock prestrain on the microstructure of the test materials were examined using optical microscopy, which revealed features which may be deformation twins. The results of these examinations and how they correlate with the effects of shock prestrain on deformation stability under dynamic loading are discussed.

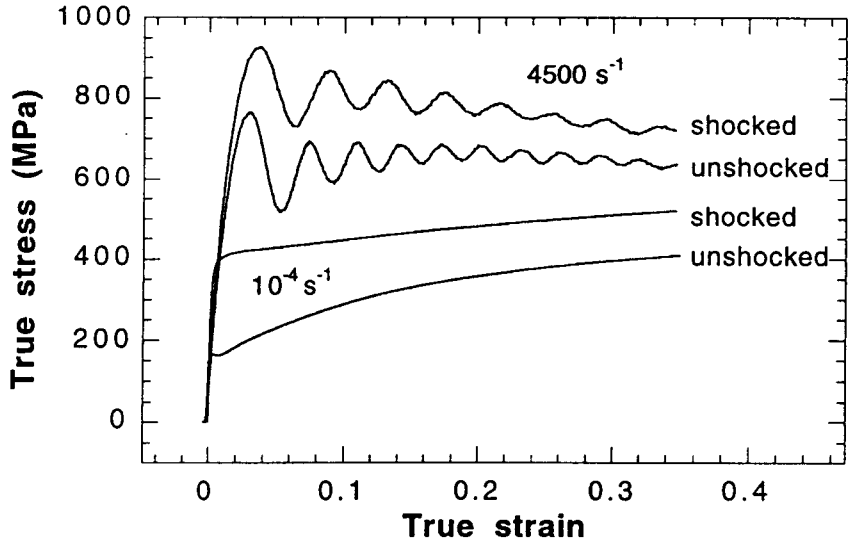

Figure 1. Mechanical behavior of unalloyed Ta in the shocked and unshocked conditions at strain rates of 10^{-4} s^{-1} and 4500 s^{-1} in compression.

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